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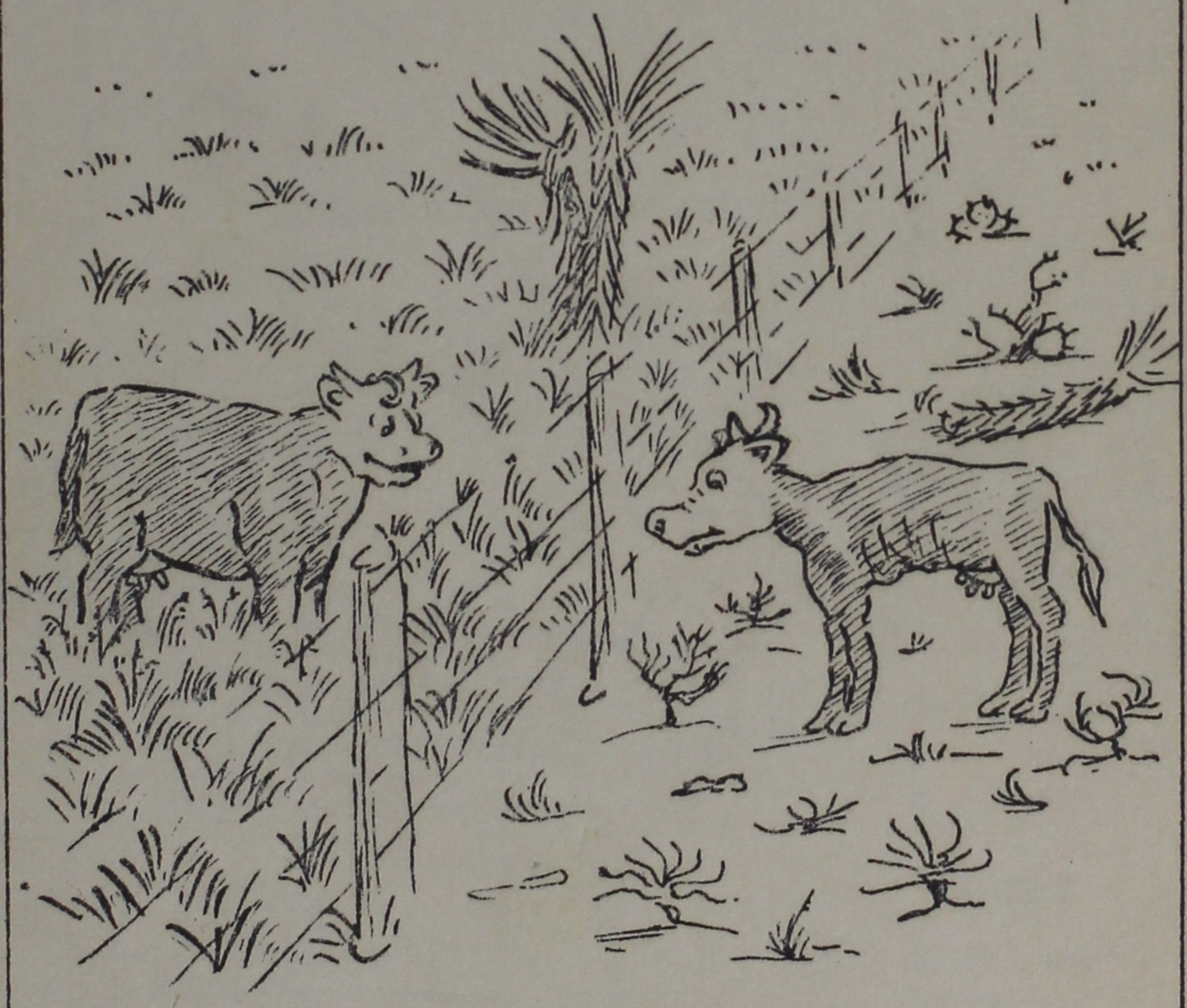
THE
SOUTHWESTERN FOREST AND RANGE EXPERIMENT STATION
NEW MEXICO AGRICULTURAL EXPERIMENT STATION
AND
NEW MEXICO EXTENSION SERVICE

WELCOME YOU TO THEIR

RANCH DAY

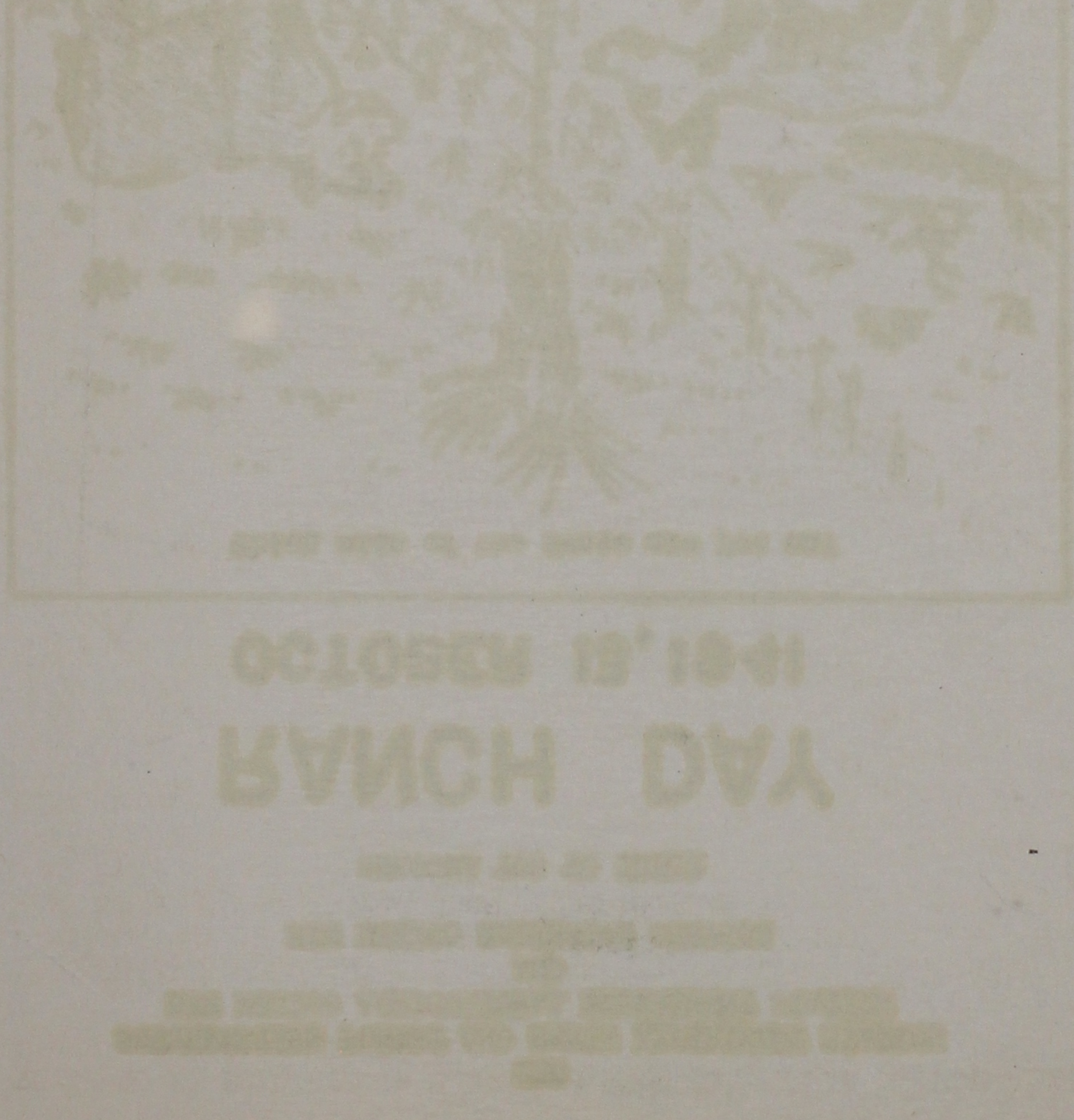
OCTOBER 13, 1941

Which side of the fence are you on?



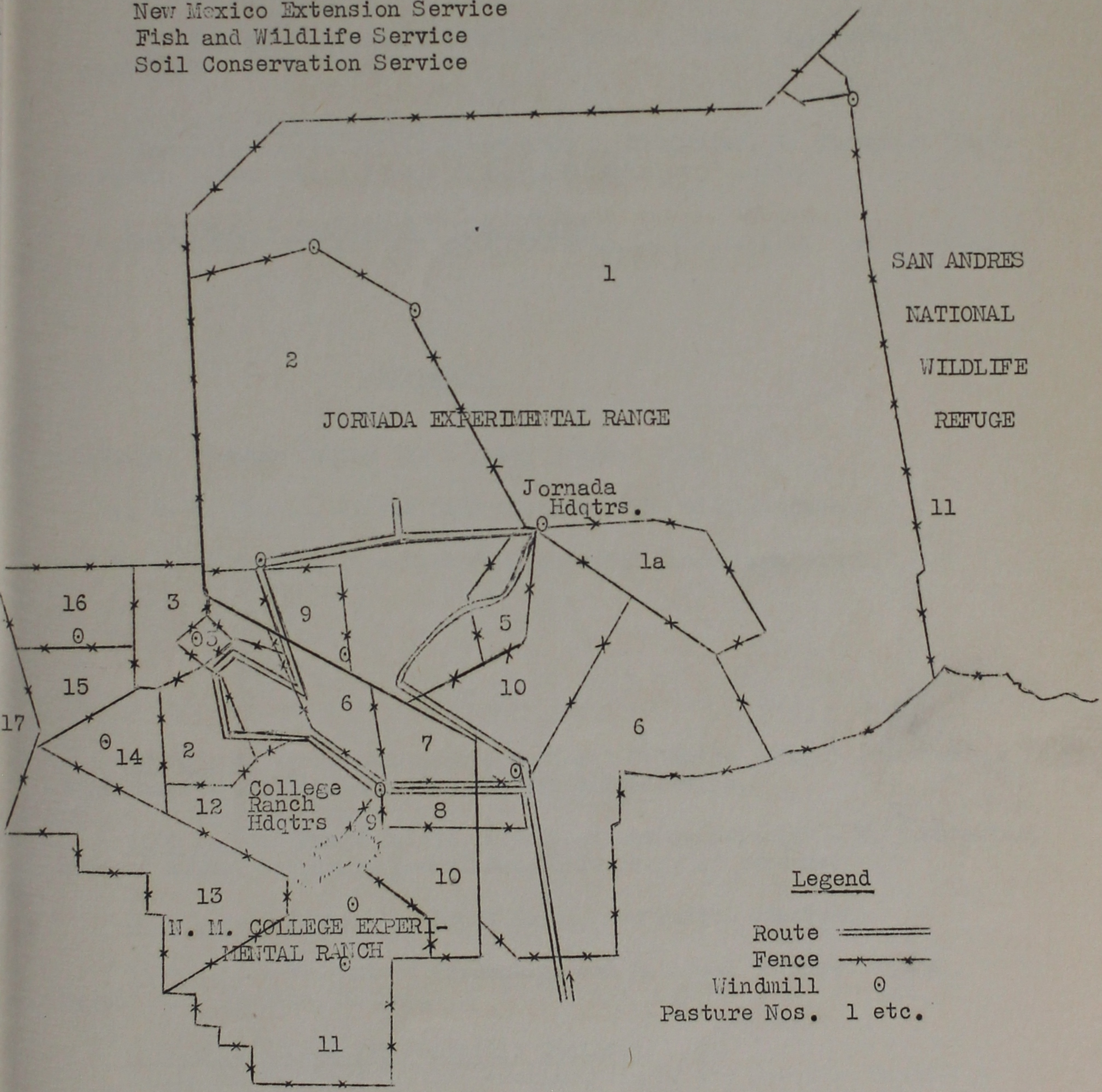
More beef for defense will result from more feed per cow rather than more cows to consume limited feed resources.

THE JORNADA EXPERIMENTAL RANGE
(Celebrating its 25th Anniversary under Forest Service supervision)
AND
THE COLLEGE RANCH



ROUTE TO BE FOLLOWED ON RANCH DAY TOUR OF JORNADA EXPERIMENTAL RANGE AND COLLEGE RANCH

Cooperating Agencies:
Southwestern Forest and Range Experiment Station
New Mexico Agricultural Experiment Station
New Mexico Extension Service
Fish and Wildlife Service
Soil Conservation Service



PROGRAM

George Ellis, Extension Animal Husbandman, Presiding

7:30 a.m. - Leave Las Cruces

8:15 a.m. - Entrance Gate - Jornada

Introduction of personnel of New Mexico A. & M. College Animal Husbandry Department and Southwestern Forest & Range Experiment Station.

"The Jornada Experimental Range" - Fred N. Ares, Superintendent, Jornada Experimental Range.

9:00 a.m. - Pasture No. 2

"Economic Forage Utilization" - W. G. McGinnies, In Charge of Range Research, Southwestern Forest & Range Experiment Station.

10:10 a.m. - Snakeweed Mowing Plots

"Grass, Shrubs and Maintenance of Grazing Capacity" - K. W. Parker

SUPPLEMENT

An additional speaker during the noonday program will be:

Mr. R. H. Royall, Silver City stockman, who will discuss

"A Good Breeding Program is a Part of Successful Ranch Management."

12:55 a.m. - "The San Andres National Wildlife Refuge" - Arthur Halloran, Refuge Manager, Fish and Wildlife Service.

1:00 p.m. - "Range Cattle Investigations in Arizona" - E. B. Stanley, Head of Animal Husbandry Department, University of Arizona.

1:15 p.m. - Remarks by Louis Angel, New Mexico stockman.

1:30 p.m. - "Livestock Production and National Defense" - A. D. Brownfield, Florida, N. Mex.

2:00 p.m. - Mesquite Sandhills Enclosure

"Some Observations of the Deterioration of the Mesquite Sandhills Range Type and of the Factors Responsible for the Deterioration" - Kenneth A. Valentine, Junior Range Examiner, Jornada Experimental Range.

"Rabbits and Rodents in Relation to Grazing Lands" - Albert H. Trowbridge, Biologist, Fish and Wildlife Service.

(Over)

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"Reseeding of Range Grasses in New Mexico" - Charles G. Marshall, Head of Nursery Division, Soil Conservation Service.

11:10 a.m. - Headquarters (See exhibits on display here)

Demonstration showing the best kind of range cows. George Ellis, Extension Animal Husbandman.

11:45 a.m. - Lunch

12:30 a.m. - Welcome

By P. V. Woodhead, Assistant Regional Forester, commenting on 25 years' progress in range management.

12:40 a.m. - Remarks by B. A. Christmas, cooperating stockman and owner of livestock grazed on Jornada Experimental Range.

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(Over)

3:00 p.m. - Camp Well (College Ranch)

"Results from Five Years of Range Experiments with Yearling Steers"- By J. H. Knox, Head, Animal Husbandry Department, and P. E. Neale, Associate Animal Husbandman, New Mexico A. & M. College.

4:00 p.m. - Reseeding Plots

"Methods of Soil Preparation on Range Land as a Factor in the Success of Reseeding" - J. O. Bridges, Assistant Animal Husbandman, New Mexico A. & M. College.

THE JORNADA EXPERIMENTAL RANGE

By Fred N. Ares, Superintendent

History

Twenty-five years ago the Forest Service took over the control and administration of what was then called the Jornada Range Reserve. Three years earlier, in response to popular demand, President Taft had, by proclamation, set aside the area for experiments in pasture management and for breeding horses for military purposes. It was then under the administration of the Bureau of Plant Industry of the Department of Agriculture, but in 1915 its control passed to the Forest Service of the same Department.

The first director of the range was E. O. Wooton, co-author of Wooton and Standley's "Flora of New Mexico." He was succeeded by C. E. Fleming in 1915 at the time control of the area passed to the Forest Service. Since then, progress of the experimental work has been directed and observed by several range specialists including James T. Jardine, now Director of Research for the Department of Agriculture; C. L. Forsling, now Assistant Chief in charge of Research for the Forest Service; W. R. Chapline, in charge of Range Research for the Forest Service; L. C. Hurtt, now in charge of Range Research at the Northern Rocky Mountain Experiment Station; Enoch Nelson, professor of Range Ecology, Colorado State Agricultural College; J. D. Schoeller; and R. S. Campbell, who is now assistant to Mr. Chapline in the Washington Office of the Forest Service. The Jornada Experimental Range since 1930 has been operated as a branch of the Southwestern Forest and Range Experiment Station, Arthur Upson, Director, with headquarters at Tucson, Ariz.

During the quarter century period, four stockmen have, at different times, cooperated in the work by furnishing the experimental

herd grazed on the range. These men were C. T. Turney of "T Hook" fame, now deceased, from 1915 to 1924; W. H. Waggoner from 1925 to 1932; B. A. Christmas from 1933 to 1937; Jerry Clayton, 1938; and B. A. Christmas from 1939 to the present time.

General Description of the Range

The Jornada Experimental Range has an area of approximately 193,520 acres. Since it is located in the low-rainfall area and includes portions of the more important range types found in the Southwest, it is well adapted to range investigations on semidesert range lands. The results of such experimental work have a wide application as the Jornada is typical of several million acres of range land found in the lower elevations of the Southwest.

The four principal range types found on the Jornada are as follows:

1. Black grama and associated species. The black grama type has the highest grazing capacity of all the range types represented on the Jornada Experimental Range. Black grama, which makes up most of the forage in this type, is suitable for year-long grazing as it continues palatable throughout the year but will withstand grazing better if use is deferred until after the growing season.

2. Tobosa grass type. Tobosa grass occurs in pure stands or is intermixed with burro grass in the swales or depressions which receive run-off from higher elevations. Neither of these grasses is highly relished, but tobosa grass is fairly palatable while green and succulent in late spring and summer. The best use can be made of this range type in summer.

3. Mesquite sandhill type. Roughly one-third of the entire Jornada area is occupied by mesquite sandhills. This range has low

grazing capacity and is used mostly during the late winter and early spring seasons when a crop of annual weeds may be expected. Chamiza, a valuable browse plant, is also present in this type.

4. Tarbush-creosotebush type. This is one of the poorest southwestern range types and occupies about one-fifth of the Jornada area. These shrubs have no forage value whatever, and grazing use is possible only because of the small amount of perennial weeds and grasses found in this type.

The experimental herd used on the range does not belong to the Government but is owned by Mr. B. A. Christmas and operated by him under a cooperative agreement with the Secretary of Agriculture.

Range Management and Investigations

The principal purposes of the Jornada work have been to carry on grazing experiments and investigations to determine and demonstrate improved methods of managing and utilizing range lands for livestock production and to obtain reliable data on related technical and practical phases of range management and utilization of value to public and private owners of range lands in southern New Mexico and adjacent States. This was accomplished by the adoption and continued use of a carefully planned scheme of handling cattle on the range.

Prior to the establishment of the Jornada, the greatest problem of ranchers in the vicinity was the severe losses of cattle incurred during the frequent droughts. Sometimes entire herds were wiped out in a single year. This was caused by the ranges being stocked beyond their capacities, and at that time there existed no information as to the correct rate of stocking under which range could be maintained. The average rate of increase or calf crop was poor; if the rancher got a 40-percent crop, he was considered lucky.

In order to determine the correct carrying capacity of the range intensive surveys were made of all the range types. The stocking of the area was then adjusted accordingly, the stocking of the breeding herd being based on the poorer years instead of on the best years as formerly. As the years passed, actual stocking records were accumulated, and these, together with the data obtained from range surveys, served to establish an average rate of stocking under which the range could maintain itself. In order to provide reserve grazing capacity for drought periods, the average rate of stocking determined by the above methods was reduced by 25 percent to allow a sufficient margin to take care of forage needs during most of the below-average years.

Under this conservative system of stocking, early adopted for the Jornada range, losses began to decline and have been kept well down during the 25-year period. The average annual death loss from all causes for the period 1915 to 1941 is less than 2 percent. At the same time costs of supplemental feeding have been reduced to a minimum, the grade of cattle greatly improved, and calf crops increased to an average of 70 percent. For the past decade calf crops have averaged nearly 80 percent.

In order to secure the fullest possible use of the range, the management plan provides for seasonal use of the range, facilitated by the division of the area into seven pastures roughly separating the winter and summer range. The winter range consists mostly of the valuable black grama since it is palatable throughout the year. Deferred use of this range during the growing period is made possible by the large amount of tobosa and burro grass used exclusively for

summer grazing. The summer grazing period runs approximately for 4 months beginning in July and ending in October. During the balance of the fall, winter, and spring, the cattle graze the black grama areas with light use of the mesquite sandhills in early spring.

The estimated capacity for the entire Jornada, determined through past performance of the range, is 1,215 head of cattle year long. This means that the surface-acre requirement is about 160 acres per cow year long or an average stocking rate of 4 cows year long per section of range. As pointed out in the above discussion of range types, a considerable part of the area is so poor in quality that it would hardly support a cow to the section year long while other parts have a capacity of 10 and 12 head per section.

Of the total 1,215 head of livestock run on the Jornada, only 65 percent or 784 head represent the permanent herd consisting of breeding cows, replacement heifers, bulls, and the saddle horses necessary to handle the cattle. The 35 percent remaining, amounting to 431 head year long, includes short-season and quickly marketable livestock such as cull cows, bulls, and the yearlings held for spring or fall sale depending upon the amount of feed produced during the current year. This plan of stocking the range insures that there will always be enough forage for the base or permanent herd while in un-usually good years yearlings and calves can be held over to utilize surplus feed. In case of drought this temporary herd can be disposed of during the fall. This system of livestock management makes it possible to follow the fluctuations of forage production from year to year without overstocking the range.

Distribution of cattle is effected by the use of salt placed on the range where use is desired, by fencing, and by use of water

developments. The permanent water system consists of seven deep wells (average depth 350 feet), 12 large surface tanks, and 48 small water holes. The permanent water developments serve the year-long or winter range while the tanks and water holes supply water for cattle grazing the summer range. The large number of water holes were built in 1933 and 1934. The cost was around $90 each using CCC labor. An average excavation of 271 cubic yards of earth was required for each tank, and under ordinary use, they hold water for 6 weeks. These developments have materially aided in holding cattle on the tobosa or summer-grazing areas thus permitting the desired deferred use of the year-long black grama range. Electric 1-wire fences have been used to confine cattle on tobosa range, but because of the extremely dry soil, they have been only partially effective.

Supplementing the range management plan, good animal husbandry practices have also served to reduce death losses, improve the grade of cattle, increase calf crops, and reduce costs of operation. The breeding herd consists of young and thrifty cows and bulls of good grade, and it is kept so by close culling each year. This removes all unproductive cows and those which are otherwise below standard.

ECONOMIC FORAGE UTILIZATION

By W. G. McGinnies
In Charge of Range Research
Southwestern Forest and Range Experiment Station

A major problem facing the stockman in the Southwest is to make the best possible use of the forage produced on semiarid ranges. This brings up the question "How closely should a range be grazed?"

Actually the problem has two phases because on the one hand the amount of forage produced determines the amount that can be grazed, while on the other hand the degree of use determines to a considerable extent future forage production. Under very favorable growing conditions, as for example on an irrigated pasture, the degree of use that can be safely obtained on grasses is determined largely by the mechanical ability of the plants to expand and grow, but under range conditions where moisture is deficient and the fertility of the soils limited, the recuperative ability of the plant is considerably decreased. Experiments have shown that under arid range conditions the ability of the plant to make regrowth is, broadly speaking, inversely proportional to the intensity of grazing. This means that the closer a range is grazed the less it will produce.

We have laid out four sets of plots the first of which represents unharvested forage conditions; the second has been lightly clipped, the third more heavily, and the fourth plot heaviest of all. These plots have been clipped to simulate grazing to meet different ideas as to the degree of utilization to which ranges of this type might be used. Although you may not find exactly your idea of proper utilization represented, it is believed that most everyone will agree that the best use on ranges of this type lies somewhere within the extremes represented.

During the past years experiments have been carried on to see what happens under these different degrees of utilization. These

investigations have had for their purpose the determination of the amount of forage produced from year to year and the reaction of the vegetation to these different degrees of use as measured by the condition of the range.

These experiments have shown that under the light degree of utilization represented in Plot B a good forage crop was produced in good years and bad. In fact, it was surprising how few droughts occurred in our pastures where this degree of utilization was practiced. There was no doubt but that forage production was held at a high level, and the range was maintained in excellent condition, but there were those among us who thought this degree of use was uneconomic because it meant running a small number of livestock. Pastures stocked on this basis will have in the neighborhood of a 25-percent reserve in average years and only in excessively dry years will there be a shortage of forage.

Pastures in plots subject to approximately the degree of utilization represented in Plot C did very well in good years, fairly well in average years, but they fell down in years of low rainfall. There was not too much difference between Plots B and C in the matter of maintaining range condition, but it was definitely noticeable that available forage under conditions represented by Plot C was much less in the below-average years. Measurements also showed that while the loss in density of plant cover was no greater than under conditions represented by Plot B recovery was much slower. The livestock were never quite as large and the calf crop averaged less.

The records show that range areas utilized to the degree represented by Plot D never produced as much forage as the other two, but in years of very high rainfall they did look pretty good. In years of average rainfall, production was always a little short, and it always

appeared that one or two more rains were needed to produce a forage crop. In the dry years range areas subject to this degree of utilization fell way low in production often necessitating the removal of livestock. But most significant, over a period of 25 years range areas subject to this degree of utilization have shown a steady decline in density of vegetation and quality of forage produced. There is now less grass and much more brush than there was in the past.

We have, then, a choice to make in the degree of utilization to be followed on ranges such as these. The first thing to consider in making such a choice is what degree of use will result in the maintenance of the range. The second consideration is what degree of use will be most productive in terms of livestock marketed. It is fortunate for all of us that experimental results show that in this range type these two basic considerations can be met by the same degree of utilization. This afternoon you will see the results in terms of calves and steers produced in pastures stocked on the basis of the utilization represented by Plot B. Some of you may feel that the stockman cannot afford to stock on such a basis, but if you care to take the time, it is believed that you can figure out yourselves that actually year in and year out the net production in terms of beef marketed under this light degree of range utilization is more than under heavier use.

Records show that a fairly good range condition may be maintained for some time under heavier degree of utilization, but considered strictly from the stockman's viewpoint, this problem of how closely to graze can be answered in terms of production. Our records indicate definitely that the productive capabilities of these southwestern ranges can be kept high and that under a system of good management breeding cows should weigh in the neighborhood of 1,000 pounds and should produce a

90-percent calf crop, the calves weighing at least 400 pounds at weaning time. If you see a range supporting such livestock, you will see, I am sure, that there is plenty of grass on the ground at all times in the year, and you can also be sure that that particular stockman has found the answer to the problem "How close should a range be grazed?"

GRASS, SHRUBS, AND MAINTENANCE OF GRAZING CAPACITY

By Kenneth W. Parker
Forest Ecologist
Southwestern Forest and Range Experiment Station

Robert Lancaster, Texas Extension Pasture Specialist, says:

"Control of noxious shrubs invading Texas grassland is the foremost problem on millions of acres and is perhaps second only to rate of stocking on many other millions. Still other millions along streams and branches occupied by brush and trees of low value are the most productive land potentially available for pasturage." Such is also the case in vast areas of both Arizona and New Mexico. The stockmen have long recognized the importance of this problem and their interest furnished the incentive for the initiation of experimental work in the Southwest.

Beginning about 5 years ago the Southwestern Forest and Range Experiment Station undertook detailed studies of methods for the control and eradication of noxious range plants such as cacti, mesquite, cedar, burroweed, and some of the plants poisonous to livestock.

One of the commonest range invaders is snakeweed. This plant is known also to stockmen as turpentine weed, rosin weed, broomweed, rockweed, matchweed, brownweed, yellow-top, yellow weed, and yerba de vibora. There is considerable evidence to indicate that snakeweed comes in following continued heavy grazing. Heavy grazing of the grasses and the other palatable plants results in a marked decrease in the natural competition of these plants to unpalatable species such as snakeweed.

There is little doubt that snakeweed was present in the early days and probably in dense stands on immature or infertile or disturbed soils, much as it is today. The first settlers noticed that it was confined to rocky ridges and gravelly slopes. In eastern New Mexico ranchers

called it "rockweed" chiefly because it was found only on rocky ridges. Then as the years went by it began to become noticeable around water holes, along trails, and wherever livestock concentrated. It was further observed that snakeweed increased rapidly in abundance following continued heavy grazing and severe droughts which killed out most of the plant cover. A severe drought also kills snakeweed, but since this plant produces abundant viable seed and makes rapid growth, recovery from the effects of drought is more rapid than in the case of grasses subject to grazing. Increase of snakeweed causes a reduction in grazing capacity because it robs the good forage plants of much needed moisture. As snakeweed requires 4 to 5 times as much water to produce a pound of dry matter as most perennial grasses, this competition is severe. Under heavy grazing the increase of snakeweed is encouraged because competition from the perennial grasses is greatly reduced. Continual and close cropping prevents adequate nutrition of the grasses and results in poorly developed root systems. However, with light grazing the perennial grasses develop extensive root systems which function so effectively as to keep the snakeweed population from increasing.

Why, then, can't snakeweed be controlled by conservative grazing? There is ample evidence to show that it can be so controlled under certain conditions. If you will look at range lands which for years have been lightly grazed, you will find but little snakeweed. That which you do find will be confined to poor soils. Where then do mechanical methods of control come in? These methods have their place first as a means of control of further spread and prevention of increase following a severe drought and second as a means of accelerating recovery of range lands which in the past have been too heavily grazed.

There is no known method which can be used which will quickly eliminate noxious range plants. Even in the case of fire the precautions necessary are often quite troublesome and labor-consuming. Broadcast burning appears to be one of the cheapest and most practical methods available; yet, when more careful study is made, we find that this is not often the case. It is difficult to get the right combination of low moisture content and large volume of inflammable material which will allow a fire to sweep the ground clean of noxious plants. When such conditions do occur it may be the wrong time of year to secure a good kill. For example, best kills of snakeweed and burroweed result from burning in May and June, a time of year when there is generally but little inflammable grass on the ground. Fire consumes 1 year's forage on the area burned and may destroy all the feed on a ranch unit if it gets out of control. Furthermore, little is known about the effect of fire on either the perennial grasses or on the soil. Fire exposes the soil to accelerated erosion and is ineffective in killing many noxious plants such as mesquite and cacti.

Since April 1938, over 200 snakeweed plots have been set up representing 24 different treatments repeated at intervals of 3 months on separate plots. The trials of the various methods at different times in the year showed that:

1. Sulphuric acid sprays, varying in strength from 2.5 to 10 percent were ineffective at all times of the year.

2. Burning was effective except during the dormant winter period.

3. Chlorate sprays, both Atlacide and sodium chlorate in concentrations of 15 percent or better were effective in killing snakeweed except during the spring, the typically dry period of the year. However, chlorates are too costly and dangerous to be recommended for general use.

4. Various mixtures of colemanite or borate ore with sodium chlorate are unsatisfactory, largely because of cost.

5. Kerosene and Diesel oil are not sufficiently effective to warrant recommendation.

6. Grubbing is effective (90 percent kill or better) at all times of the year but is best done in the dry spring or fall when the color contrast between the snakeweeds and the dry grass allows these plants to be seen more easily. Cost of grubbing will depend on the number of plants per acre. Time required for treatment will vary from 10 acres per hour to an acre per day per man.

7. Mowing gave some promise when done in May or June. A kill of 60 percent or better may be secured if done at this time. It is cheap—25 cents an acre—and can be done with an ordinary mowing machine. Mowing in June, followed by grubbing later on in the year, is feasible in many areas.

The question naturally arises: "Will eradication of snakeweed result in greater production of grass?" It will. Data collected since 1938 show that on plots which were grubbed there was a 196-percent increase in grass above that of untreated plots. In the case of burning the increase in grass was 54 percent and for plots treated with chemical chlorates sprays 14 percent the year following treatment. However, it should be remembered that follow-up treatments are necessary with any method in order to kill plants missed or unsatisfactorily treated the first time. Furthermore, a treated area will come back to snakeweed if heavy grazing is continued.

Burroweed, a plant very similar in growth habits to snakeweed, is particularly troublesome both in reducing grazing capacity and in poisoning livestock in southern Arizona. It is not killed by drought and even appears to invade grazing lands which have been conservatively grazed. However, it does come in more rapidly under heavy grazing. The same methods of control which were found to be effective in killing snakeweed are also best applied to burroweed; these are grubbing, burning, and mowing in June followed by grubbing.

This summer oxperiments were begun on methods of control of cholla cactus. This cactus often grows in such dense stands in parts of southern Arizona that it makes difficult the working of cattle and increases the number of cases of screwworms. A method that gives promise of killing cholla is as simple as jabbing a crowbar into the base of the plant. The tool consists of a long piece of 1-inch pipe with a valve and cutting edge on one end. The tube is filled with a solution of sodium arsenite, colored with Rhodamine B dye. The purpose of the dye is to enable the worker to distinguish untreated from treated plants. When the tool is jabbed into the stem about a teaspoonful of poison is released. Depending on the size of the plant, one or two jobs are sufficient. Although insofar as we know the method has never been tested, it should be equally effective on the prickly pear which is such a pest in Texas.

Work has been started on methods of control of juniper or cedar, it being objectionable principally because it is increasing in many areas to the point where it has cut down the grazing capacity. As yet we have nothing to report but hope by the next year or so to have developed a practical method for juniper control.

Ranchers throughout the Southwest within recent years have been particularly active in eradication of mesquite. In spite of its values (emergency and seasonal feed, protection to livestock from heat and storms, and use for fuel and posts), many ranchers object to mesquite because its increase has been accompanied by a decrease in grazing capacity and because of the extreme difficulty of working cattle in mesquite thickets. We have no satisfactory method to offer for the control of the low shrubby form of mesquite which is so common here in southern New Mexico other than that further spread may be prevented by grubbing/

the seedlings. However, it has been found both experimentally and under field conditions that control of mesquite in the tree form, which is more common in southern Arizona and Texas, may be economically accomplished with sodium arsenite. Ranchers interested in mesquite control should read Research Note No. 88, "The Use of Arsenic in the Control of Mesquite in the Southwest."

SOME OBSERVATIONS OF THE DETERIORATION OF THE MESQUITE SANDHILLS RANGE TYPE AND OF THE FACTORS RESPONSIBLE FOR THE DETERIORATION

By Kenneth A. Valentine, Junior Range Examiner
Jornada Experimental Range

We are making this stop to observe the results of some studies aimed at natural revegetation or improvement of this type of range. We have just passed through a considerable area which looks and is pretty bad. It is certainly much worse than the good grassland we saw this morning and some that we shall see later today.

Both soil and climatic factors are very nearly the same here as on the grassland and these facts prompt us to seek the reason for the differences in vegetation that we see.

First, let us consider the results of a study of the soil of this type of range. This soil is classed as a loamy sand and is said by the soil surveyor to be essentially the same as that found on the black grama grassland, differing only in that the surface is less compact than the surface soil of the grassland and is subject to blowing and drifting by winds. Because of this property of the soil, it becomes drifted about plants, especially the mesquite plants which are so common on the area. As the mesquite plants grow the sand drift enlarges to form a dune, and a wind-scoured depression or blow-out is formed about it. In many places the dunes are so far developed and close-spaced that the grassland has been completely converted to the all but worthless mesquite sandhills type. These progressive changes in vegetation and soil are to be observed throughout the area through which we have passed in coming to this stop. They are also illustrated diagrammatically in the accompanying figure.

Our investigations have shown that when the dune-blowout conditions are fully developed the soil of the blow-outs is less fertile than the soil which forms the dunes. In general, there are smaller amounts of the three major plant nutrients, potassium, nitrogen, and phosphorus, in the soil remaining in the blow-outs than in the undisturbed soil of the grassland nearby. These differences in soil fertility that have developed with the deterioration of the plant cover are best expressed and illustrated by plants themselves. We have therefore set up a demonstration here in which we have grown two species of grama grass on soils from barren blow-out, mesquite-covered dune, and undisturbed grassland. One of the grasses used is Parry grama (Bouteloua parryi), a native 6-weeks grama, and the other is Rothrock grama (Bouteloua rothrockii), a native of the southwestern part of the State and southern Arizona but which has been found to do well on the sandy soils here. All pots of one species have been given the same treatment including equal amounts of water and equal exposure to sun, wind, and rain.

Results of a similar pot test are presented in table 1. The same grasses and soils were used, and the plants were grown in the greenhouse. This greenhouse test, like the present demonstration, showed the blow-out soil to be consistently less productive than the undisturbed grassland soil.

Table 1.- Average weight of Rothrock grama plants (tops) and Parry grama plants (tops and roots) grown in soil of undisturbed grassland, blow-out, and dunes.

Rothrock grama			Parry grama		
Undisturbed	Blow-out	Dune	Undisturbed	Blow-out	Dune
Grams	Grams	Grams	Grams	Grams	Grams
.18	.09	.35	1.02	.29	.93
.12	.10	.19	.59	.068	.44
.13	.015	.26	.64	.018	.94
Ave. .143	.068	.266	.750	.125	.770

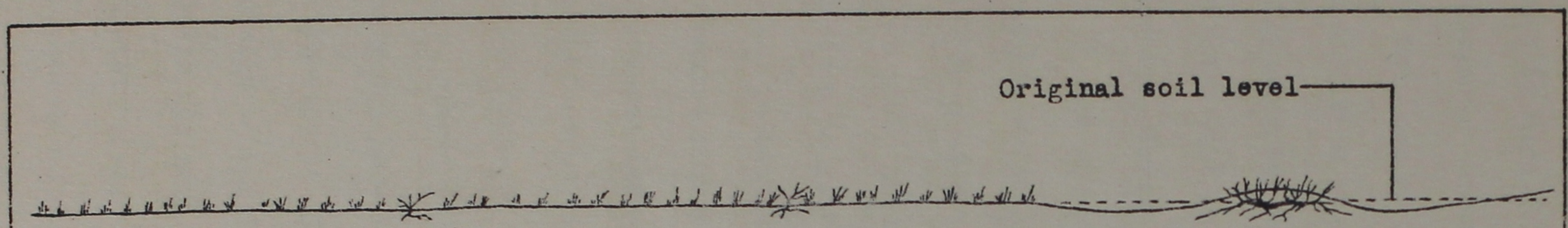

Diagram showing the change in soil surface that accompanies the development of mesquite plants on black grama grassland and the location of zones of reduced and increased soil fertility.

It is interesting to note that the soil of the mesquite dunes is much more productive than the soil of the undisturbed grassland; however, this can hardly be regarded as compensating for the loss of fertility over the blow-outs which are much more extensive in area than the dunes. Moreover, the dunes are almost fully occupied by the mesquite plants so that the benefits of the enriched soil go not to valuable forage plants but to plants of much less forage value.

Let us now turn to the consideration of rodent and rabbit grazing, a factor which contributes greatly to the deterioration and low productiveness of this type of range. We have laid out three plots here: one open to cattle and rodents (including rabbits), one open to rodents but closed to cattle since 1931, and a third closed to cattle since 1931 and rodents since 1935. In 1932 an intensive survey of the vegetation within and adjacent to the cattle exclosures was made. From this survey a summary of the vegetation conditions pertaining to the three plots in 1932 has been prepared and is compared to a summary of conditions in 1941 in table 2.

These plots have not only shown us the deterioration that the range here has undergone and the good potential production that it is capable of making, but they have also disclosed the factor chiefly responsible. We can see here that although grazing by cattle has been partly responsible for the deterioration that the vegetation has undergone, damage by rodents has been primarily responsible for the decline. In fact these plots show that rodents alone overutilize forage so severely that deterioration results. What we see here with regard to rodent damage of the range has been

Table 2.- Comparison of density and composition of vegetation on open, cattle and rodent exclusion, and cattle exclusion plots in 1932 and 1941.

	Plot open to cattle and rodents		Plot open to rodents closed to cattle		Plot closed to cattle and rodents	
	1932	1941	1932	1941	1932	1941
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Density (percent ground cover)	27	12	27	18	18	25
Composition						
Total weeds	3	22	3	22	7	1
Grasses:						
Black grama	20	12	20	17	5	32
Dropseed	24	8	24	10	5	48
Three awn	3	1	39	6	3	6
Fluff grass	1	2	1	2	1	
Bush muhly					1	
Bristle grass		2		2		2
Annual three awn				1		
Total grasses	48	25	48	38	15	88
Shrubs:						
Snakeweed	37	36	37	23	58	5
Mesquite	8	12	8	8	18	4
Soapweed	4	5	4	4	2	1
Others						1
Total shrubs	49	53	49	35	78	11

demonstrated at several other points on the Jornada and on the College Ranch. It is by far more the rule than the exception on our poorer range areas. This brings us face to face with a problem of first importance in restoration or improvement of many of our deteriorated range areas. The next speaker will discuss more fully the subject of rodents in their relation to the range.

RABBITS AND RODENTS IN RELATION TO GRAZING LANDS

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Rabbits and rodents have long been a matter of much concern due to their feeding habits, methods of burrowing, or other activities throughout the forest, range, and agricultural lands of the West.

It has been fairly well established on the Jornada Experimental Range, the College Ranch, and elsewhere by exclosure set-ups such as you see here that even in the absence of grazing by cattle neither artificial nor natural revegetation of some types of depleted range lands in the Southwest is possible without protection from jack rabbits. The presence of smaller rodents such as kangaroo rats, pack-rats, ground squirrels, etc., in several of the plots in about the same numbers as occur elsewhere on the range indicates that under some conditions they may not be of too grave concern. In other situations, however, kangaroo rats, ground squirrels, pocket gophers, or other small mammals may exert considerable adverse influence on grazing lands. Recent work has shown that under still other conditions of climate, soil, and vegetation some of the burrowing mammals may be of benefit to the range.

Additional studies in the San Joaquin Valley of California, the sand sagebrush range of Oklahoma, and in other localities demonstrate convincingly that animal populations are not constant from one year to another, or from one season to the next.

In small mammals—rabbits, various kinds of wild mice, rats, and so on—the numbers of individuals are, generally speaking, lowest

in late winter or early spring and greatest in mid- to late summer immediately following the breeding season. During the fall and winter months the numbers of animals steadily decrease due to natural mortality brought about by predators, severe weather, and other poorly understood causes.

Over a period of years, populations may increase from one animal to several acres to as many as 30 or 40 animals per acre. Then within a short period of time the population "dies off," and the increase in numbers is repeated.

Three actual cases of decline may be of interest: In California a kangaroo rat population of 30 rats per acre dropped within a 6-week period to 1 rat per 5 acres. In Oklahoma a late December population of 25 kangaroo rats, 4 packrats, and 1 cottontail rabbit had been reduced by the following mid-June to 8 kangaroo rats per acre, 1 cottontail per two acres, and no woodrats were found, although a few were probably present. During 1934 and 1935 jack rabbits were numerous over large areas of range land in south-central Arizona, slightly more than 12,000 being removed by shooting from the 40,000 acres of jack rabbit country on the Santa Rita Experimental Range. The known density, therefore, was about 1 jack rabbit per 3.5 acres. Late in 1935 a general decline in jack rabbit numbers took place over a wide area, and the population has not yet recovered to a marked degree.

In the more northerly part of the country some species of animals undergo a rhythmic change in numbers over a period of years, the low and high populations occurring at such regular intervals that it is possible, within limits, to predict them. The great majority of animals studied have not been shown to exhibit definite

cycles, but the highs and lows tend to occur at irregular intervals. In the Southwest especially, fluctuations in small animal numbers seem to be of the sporadic, unpredictable type, rather than the regular, predictable kind. Some information has accumulated that jack rabbits may be cyclic in southern Arizona, the highs and lows occurring at least 15 years apart, but lack of exact information precludes definite statements about this at present.

Studies of the food habits of wild animals has given us a good idea of what many of them eat, and in some cases of how much they eat. It has been found particularly difficult to secure as precise information as could be desired for such animals as the jack rabbit, although considerable detailed work has been done on them. One estimate states that in southern Arizona 60 blacktailed jack rabbits will consume as much vegetation as one cow, but since only 41 percent of the food by volume consists of valuable forage species, 148 rabbits would be required to consume as much forage as one cow. Possibly the estimate as to the amount of forage consumed is somewhat in error, but it surely falls within 50 percent of being correct for the conditions studied. We might take then, as a working basis only, the figure 75 jack rabbits equal one cow. Additional studies might modify this concept.

Those of you who ride the range or hunt a good deal know that different kinds of animals live in different kinds of places. This principle is strikingly borne out by the distribution of the rabbits and smaller mammals on this range. In the mesquite sand hills type last August there were found to be about 30 kangaroo rats, 10 packrats, 2 ground squirrels, 10 smaller mice, and about 2 cottontails per acre. Possibly there was one jack rabbit per 20 acres, although

this figure is pretty much of a guess. Actual figures were not obtained for the snakeweed-grassland type, but general observations indicated that the small mammal population was somewhat lower, while in the black grama type the number of small mammals was probably less than half as great as in the mesquite sand hills.

There is distinctly different species composition under the several conditions of vegetation, the mound-building bannertail kangaroo rat living only on the firmer soils in the snakeweed and black grama types, whereas the small Ord's kangaroo rat is found only in the lighter sandy soils. The two species seldom are found together. Packrats are not numerous in the best developed grassland, but as many as 20 to 25 per acre occur where yucca is especially dense. Other differences are also found.

During August and the first few days of September repeated counts were made at night of the rabbits along several of the trails of this range. The results of these counts are given in table 1.

Table 1.- Results of rabbit counts made on different parts of the Jornada Experimental Range August 15 to September 3, 1941.

Routes over which counts were made	Total miles driven	Number of counts	Number of rabbits seen: Jacks	Number of rabbits seen: Cottontails	Average number of rabbits per mile: Jacks	Average number of rabbits per mile: Cottontails
Headquarters to West Well (6 mi.)	138.0	23	375	615	2.64	4.46
East side of West Well (.1 mi.)	2.3	23	164	110	71.30	47.87
West side of West Well (.2 mi.)	1.6	8	94	37	58.75	23.13
West Well to College Gate (1.7 mi.)	13.6	8	30	21	2.21	1.54
College Gate to South Well (6.7 mi.)	53.6	8	18	27	.34	.51
Vicinity of South Well (.2 mi.)	1.6	8	128	3	79.99	1.88
West Well to Red Lake (7.6 mi.)	106.4	14	169	190	1.58	1.79

One of the things brought out by the data of this table is that although rabbits are fairly uniformly distributed over the range there is considerable variation in density of the rabbit population from place to place. Another point brought out is that jack rabbits tend to concentrate about West Well and South Well where many of them were generally seen. Taking the range as a whole jack rabbits were found to be about seven times more numerous in the snakeweed-grass, mesquite-sand hills types between Headquarters and West Well than they were in the black grama type between College Gate and South Well. Around the east side of West Well jack rabbits averaged one rabbit per 1.4 acres. The calculated per-acre density between Headquarters and West Well and between College Gate and South Well was, respectively, one jack rabbit per 38 acres and one jack rabbit per 290 acres. For a number of reasons these latter figures are considered to be somewhat low, but they serve to emphasize the relative difference in density of jack rabbits under the different conditions of vegetation. They also show that rabbits are not nearly so numerous as casual observation would indicate.

The value of the foregoing kinds of information may more readily be appreciated if we think in terms of applicability to range management. A single example will suffice.

To date no very successful means of controlling jack rabbits on the open range has been developed, and the Fish and Wildlife Service has recently assigned Mr. Keith McKee, with headquarters at Las Cruces, to develop control methods for this animal. Points which he must consider are: (1) the food and feeding habits of the animals, (2) general distribution of the rabbits, (3) numbers of rabbits, (4) daily and seasonal movement of rabbits, (5) activity of the rabbits as influenced by weather conditions, season, and so on.

Studies in range management must take into account the effect of different numbers of rabbits on different types of vegetation under varying conditions of density. It is indicated that during a series of good years a relatively large jack rabbit population might remove an inconsequential portion of the forage, whereas during a series of poor years a relatively few rabbits might do a great deal of harm to the range. Here on the Jornada jack rabbits have been sufficiently numerous through a period of years to prevent reestablishment of useful vegetation on areas totally protected from cattle. It is fairly certain that the numbers of rabbits have fluctuated from year to year but to what extent is not known. Nor is it certainly known how much country a jack rabbit ranges over in the course of daily and seasonal movements. More definite answers must be secured for several questions of similar nature. That in brief is the job for future research.

RESULTS FROM FIVE YEARS OF RANGE EXPERIMENTS WITH YEARLING STEERS

By J. H. Knox, Head, Animal Husbandry Department,
and P. E. Neale, Associate Animal Husbandman,
New Mexico State College

In previous Ranch Day reports, the advantages of running yearling steers as part of the stock on ranges such as these have been stated. These reports have shown that such steers are producing more beef for the feed consumed than cows on the same range. It has been stated that the returns per section of range grazed by steers have been greater, in spite of the fact that steer calves usually sell for a higher price per hundredweight. Perhaps the most important advantage of this plan is that it makes adjustment to ordinary variation in forage production easy. At shipping time, after the season's crop of grass has been made, the ranchman can decide how many steer calves to keep, in view of the amount of grass that is available. These steers may be readily disposed of at any time during the following year when feed conditions seem to require it, without the financial sacrifice frequently incurred by selling breeding cattle at such times.

During the five years that these studies have been conducted, the things which have shown up most clearly are the rapid and economical gain made by the steers and the difference in gains made by individual steers in the same year. A means of selecting the steers which would make the greatest gain and return the most profit would be of great value. We soon found that picking what appeared to be the best calves at weaning time would not do the job. Neither have we been able to find a single point of conformation or group of such points in the weanling which indicate with certainty that he will be

profitable as a yearling. However, there has been a marked and fairly constant correlation between weaning weight and the gain during the following year. There are a number of common causes for variation in the weaning weights of calves from the same range in any given season. The most important of these are: Age at weaning, amount of milk furnished by dam, the inherent ability of the steer to gain rapidly, and occurrence of disease or injury.

Table 1.- Gains made by yearlings of different weaning weights (from 1936 to 1940).

Groups based on weaning weight	Steers on good range					Heifers on poor range				
	Light under 361#	Medium light 361-420#	Medium heavy 421-480#	Heavy 480# and above	All steers	Light under 361#	Medium light 361-420#	Medium heavy 421-480#	Heavy 480# and above	All heifers
Weaning weight av.age 7 mos.	319.1	395.0	452.4	514.8	449.0	314.3	395.8	446.2	507.4	428.4
Final weight av.age 19 mos.	685.6	745.6	813.4	840.6	792.5	587.0	625.2	661.3	696.4	645.3
Gain in 12 mos.	366.5	350.6	351.0	325.8	343.5	272.7	229.4	215.1	189.0	216.9
Percent gain is of weaning weight	114.8	88.7	77.6	63.3	76.5	86.7	57.9	48.2	37.2	50.6

Calves that are light because of being young, lacking milk or having had temporary afflictions from which they recovered are most likely to make rapid and economical gains the following year. On the other hand, those that are light because of a lack of natural vigor and ability to grow rapidly or that have not recovered from injury or disease are likely to make poor gains as yearlings, for the same reasons that they failed to make good gain as calves. Therefore,

weaning weight alone cannot be depended upon to select only steers which will gain rapidly as yearlings. But, as table 1 shows, the lighter calves, on the average, gain considerably more than the calves which are heavy and fat at weaning time. The record for yearling heifers for the same years has been included to show that the same principle holds for them when run on a different type of range. Other points of interest in this table besides the effect of weaning weight on the yearling gain are that lighter calves do not catch up with the heavier ones in average weight and the percentage of the weaning weight which is gained in the next 12 months. Work in feeding trials at other stations has shown that the steers which gain the largest percentage of their original weight require less feed to put on a pound of weight. Therefore, the difference between 114 percent gain for the light calves and 63 percent gain for the heavy ones would seem to be of great importance.

Table 2.- Production of yearling steers compared with breeding cows.

Weight groups	Gain per head	Percent of feed for 1 cow consumed by 1 steer	Number of steers grazed on feed for 1 cow	Gain produced by steers from feed for 1 cow	Percent of production of 1 cow made by steers from same feed 1/
	Pounds	Percent		Pounds	Percent
Light	366.5	59.2	1.69	619.4	154.7
Medium light	350.6	62.3	1.61	564.5	141.0
Medium heavy	351.0	66.6	1.50	526.5	131.5
Heavy	325.8	68.0	1.47	478.9	119.6
All steers	343.5	65.4	1.53	525.6	131.3

1/The average production for each breeding cow on the experimental range from 1937 to 1940 inclusive was 400.4 pounds with an average calf crop weaned of 91 percent and average calf weights of 440 pounds.

Since the ranchman's problem is to decide whether to replace part of his cows with steers, he is interested in the comparative production of these classes of cattle. In table 2 this comparison is made. The relative amount of feed consumed by cows and steers in each weight group was calculated from the amount of feed required for maintenance and the weight produced in each case. We hope soon to check these figures with careful measurements being made on the amount of forage actually consumed. In the meantime, we believe that the figures given are sufficiently accurate to show major differences. The record for 1936 was not included in calculating the production from breeding cows. The production in this year was low because of a poor calf crop as a result of a drought in the three years preceding. As this had no effect on the gain made by the steers in 1936, a fairer comparison is made when the calf records are taken from the years 1937 through 1940. It may be seen that all the steers produced about 30 percent more than cows from the same feed. The light steers produced 50 percent more and even the heavy calves produced about 20 percent more than cows from the same amount of feed.

The statements made above do not tell the whole story. One of the principal reasons that calf production has been so popular with ranchmen is that steer calves usually sell for a higher price per pound than other cattle. The results of a study of some of these factors are presented in table 3. Use of current prices has resulted in higher than average value, but should not affect comparisons. The price for mixed steers and heifers must be used in placing a value on the calf crop, a point sometimes lost sight of in comparing steers and calves. Although steer calves do not always sell for more per

Table 3.- Financial returns from yearling steers of different weaning weights

Weight groups	Weaning record		Yearling record		Increase in value	Number of steers consuming feed of 1 cow	Return by steers for feed of 1 cow	Percent of return from 1 cow made by steers from same feed1/
	Average weight	Value per head	Average weight	Value per head				
	pounds		pounds					percent
Light	319.1	$36.90	685.6	$70.27	$33.37	1.69	$56.40	131
Medium light	395.0	$44.44	745.6	$76.42	$31.98	1.61	$51.49	120
Medium heavy	452.4	$50.89	803.4	$82.35	$31.46	1.50	$47.19	110
Heavy	514.8	$57.91	840.6	$86.16	$28.25	1.47	$41.53	96
All steers	449.0	$50.51	792.5	$81.23	$30.72	1.53	$47.00	109

1/Average return from each breeding cow was $43.04 (400.4 lbs. at $10.75 per cwt.)

Cattle prices used: Yearling steers $10.25 per cwt.
Steer calves $11.25 per cwt.
Mixed steer and heifer calves $10.75 per cwt.

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pound than yearlings, it must be considered the normal thing, and therein lies another advantage for carrying the lighter calves over as yearlings. Not only the gain, but the original weight, must be sold at the lower price. For this reason it is an advantage to start with 350- rather than 500-pound calves. An exception to this rule occurs when the price of cattle is advancing rapidly. Table 3 indicates that all the steers returned about 9 percent more in dollars and cents for the feed eaten than breeding cows, while the light-weights returned about 30 percent more and the heavy calves about 4 percent less than breeding cows. These are probably understatements of the advantages for steers. Not more than 80 percent of a breeding herd is made up of cows of breeding age. The breeding herd requires more attention and more risk of loss is involved than with steers.

From the work reported, it seems that a ranchman can have the advantages of a herd which can be more easily adjusted to the condition of his range and at the same time increase his net income by stocking part of his range with yearling steers. Except in periods of rapidly advancing prices, the light steer calves have made more profitable yearlings than the heavy calves.

It should not be concluded that the Experiment Station recommends stocking ranches entirely with yearling steers. In most cases this leaves the rancher too much at the mercy of fluctuating prices. It must also be admitted that a year when steer calves are selling for 12 cents a pound may not be the most favorable time to start such a plan. It is generally believed that high prices are more likely to come down than go still higher.

METHODS OF SOIL PREPARATION ON RANGE LAND AS A FACTOR IN THE SUCCESS OF RESEEDING

By J. O. Bridges, Assistant Animal Husbandman
New Mexico State College

Revegetation work at this Station has been concerned chiefly with the testing of species and with the testing of methods of soil preparation and planting. We have stopped at a "Methods of Preparation" test. Two species of grasses were used in this test; Rothrock grama, a native of southern Arizona, which you see on the lower side of this strip; and Lehmann lovegrass, a native of South Africa, which is growing on the upper side of the strip.

These two species were selected for this trial as a result of species tests which extended over a period of 5 years and included tests with 120 different kinds of grasses. They have consistently given good results and are the only ones that have reseeded themselves under range conditions.

The plots are 1/4 acre in size and all were seeded by the same method at the same time. Since this was to be a methods-of-preparation test, the rate, the depth, the time, and the method of seeding, were those that have been found to be the best in this locality. Pure seed with little or no chaff in it was used with both species. The rate used was 1-1/2 pounds to the acre. This rate seems to be satisfactory for Rothrock grama but perhaps a little too heavy for Lehmann lovegrass. The seeds were sown by the use of a single-disk drill. They were run through the grass-seeder attachment but were allowed to fall directly to the ground where they were covered by running the disks as lightly as they could be set. This covered the seed from 1/4-to 1-inch deep. The plots were not seeded individually; the drill was run across all the plots each trip through the field. These plots were seeded July 18, 1940. Nothing

was done to control the weeds, as experience has shown that in this locality the weeds are not rank enough to shade the seedlings excesively and the presence of the dead weeds the next spring is desirable to help control blowing.

From the type of fence around these plots, you will see that they have been protected from rabbit and cattle grazing but not from squirrels and kangaroo rats. The latter, however, have been controlled somewhat by the use of poisoned oats.

There are six plots of each species in the series running across the field and one of each species in the two plots next to the fence and just above the strips. Reference to the following diagram will give the method of preparation used on each plot:

Plowed furrows with 4' horizontal interval					
Lehmann lovegrass	Rothrock grama				
L e h m a n n		l o v e	g r a s s		
No soil preparation	Harrowed with spike tooth harrow	Single disked	Undercut	Double disked	Listed with 4' horizontal interval
R o t h r o c k		g r a m a			

The only method used that will need explanation is the one termed "undercut." An iron blade was attached to an implement that caused it to run about 3 inches under the surface of the ground. This cut all the native vegetation loose but left it im position to act as a mulch. The lister furrows were about 8 inches deep and the plowed furrows were about 5 inches deep.

The results of this test are quite evident. The plots next to the fence which received no preparation have very poor stands. Rather exact measurements show these plots to have only 1/5 as many plants present as do the other plots. As to the other methods of preparation, there seems to be very little difference between them. The spike harrow represents the least amount of preparation and in these tests on this light soil, it seems to be sufficient. If there was more native vegetation present or if the soil was heavier, it likely would not be enough. The things to be accomplished in seedbed preparation are to kill the native plants present and to make a receptive surface for the grass seeds, and yet not make the soil too loose.

All things considered, it seems that listing on the contour is the best method of preparation, yet our results would indicate that double disking is just as good in this situation, where the plots are protected from rabbit grazing. Farther up the hill some 1-acre plots were planted at the same time as these but were not protected from rabbits. The same methods of preparation were used, except that the spike-harrow and single-disk methods were n't included. The listed plot is much superior to all the others and the plot with "no preparation" has hardly a single plant on the entire acre.

If you will move up to the corner of the fence, it will be possible to see the effect of rabbit grazing on an area planted to a mixture of these two species on land prepared by "plowed furrows" and with "no preparation."

The strip for about 130 feet immediately above the fence was prepared by plowing furrows on the contour at 4-foot intervals. Beyond this, six acres were seeded on land with "no preparation." The results,

here again, are very evident. "No preparation" did not produce enough plants even to be called a stand; while on the "plowed furrows" there is a stand, although a poor one, due to the depredations of rabbits. The initial stand on this area was just as good as on the inside plots.